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Growing Vegetable under Protected Condition NER (North East Region)

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India is the second largest producer of vegetable crops in the world. However, its vegetable production is much less than the requirement if balanced diet is provided to every individual. There are different ways and means to achieve this target, e.g., bringing additional area under vegetable crops, using hybrid seeds, use of improved agro-techniques.

Brief about NEH region

The North Eastern Hill (NEH) region comprising of eight states namely Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim lie between 21.5o N - 29.5o N latitudes and 85.5 o E - 97.3 o E longitudes. In the whole of NEH region, about 35% area is in the plains and the remaining 65% area is under hills. Net sown area is highest in Tripura (23.48%) while Arunachal Pradesh has lowest net sown area in the region. Cropping intensity is also highest in Tripura (156.5%) followed by Manipur (152.1%), and Mizoram (136.36%). NEH region is not a single entity; it has the area receiving the world's highest rainfall and also rain shadow areas receiving very less rainfall. It has valley plains as well as high peaks and warm tropical to temperate climate. Meteorological parameters common to this area is moderate to high rainfall (101 to above 400 cm of mean annual rainfall), cool to moderate temperature (below 20oC to 25oC of mean annual temperature) and high humidity (mean annual humidity above 85%).

The total area under vegetables crops in NEH region is 0.37 million ha while the total production is 4.05 million tonnes. The average productivity of NEH region (11.01 t/ha) is below the national average productivity (15.16 t/ha). Certain factors, i.e., high rainfall, shortage of irrigation facilities from November to March, non-availability of quality seeds and low temperature etc., are responsible for this low yield. Cultivation of vegetables under protected conditions (polyhouse or greenhouse) is one of the solutions that could increase the production as well as productivity of vegetables crops in this region. There are certain vegetables, which cannot be grown due to high rainfall from April to October. From October to February (winter season), the temperature is low. During this period, vegetables can be grown successfully by protecting them from heavy rainfall and low temperature. Production of vegetables under protected conditions involves protection of production stages of vegetables mainly from adverse environmental conditions such as temperature, high rainfall, hail storms, scorching sun etc. Protected conditions for vegetable production are created locally by using different types of structures. These structures are designed as per the climatic condition requirement of the area. Besides temperature, wind velocity and soil conditions play major role in the design of protection structures for growing.

Therefore, in the present scenario of perpetual demand for vegetables and drastically shrinking land holding, protected cultivation of vegetable crops suitable for domestic as well

as commercial purposes is the best alternative for using land and other resources more efficiently.

Why Greenhouses

1. Socio-economic consideratio n:As a profession, agriculture is not attractive for the educated youth, which is partly due to the drudgeries associated with fieldwork. To motivate the educated youth agriculture has to be developed to be a remunerative and drudgery-less industry as competitive as any other industry using agro-technologies like greenhouse. Then only a sense of pride will be associated with agriculture. This is especially true for the NEH region where percentage of literacy among indigenous people is higher than national average.

2. Geographical consideration: The topography of NEH region is not uniform. Some of the areas are inaccessible as well as inhospitable where normal cultivation is not possible. To cater the needs of the population in inaccessible areas greenhouse cultivation could be an answer. There is a very good and sustainable demand for fresh vegetables around the cities and towns.

Principle of greenhouse

A greenhouse is generally covered with a transparent material such as polythene or glass. Depending upon the cladding material and its transparency major fraction of sunlight is absorbed by vegetable crops and other objects. These objects in greenhouse in turn emit long wave thermal radiations for which cladding material has lower transparency. With the result, solar energy is trapped and raises the temperature inside the greenhouse. This is popularly known as greenhouse effect. This rise in temperature in greenhouse is responsible for growing vegetable in cold climates. During summer months, air temperature in greenhouse is to be brought down by providing cooling device. In commercial greenhouses besides temperature-controlled humidity, carbon dioxide, photoperiod, soil temperature, plant nutrients etc. facilitate round the year production of desired vegetable crops. Controlled climatic and soil conditions provide an opportunity to the vegetable crops to express their yield potentials.

Benefits of Greenhouse

1. Vegetable forcing for domestic consumption and export: During winters in NEH region, the temperature and solar radiations are sub-optimal for growing off season vegetables namely tomato, capsicum, brinjal, cucumber, okra and chilli. In tomato, low temperature and low radiation cause puffiness and blotchy ripening. Hence during extreme conditions of winter season (October-February), these vegetables will be cultivated under polyhouse. In a medium cost greenhouse, an yield of tomato and capsicum can be taken @ 98.6-110.5 tonnes/ha and 87.2 tonnes/ha, respectively. The protected environments would be well adapted in the field where winter is prolonged. A polyhouse can be made which will receive sunlight for growing chilli, tomato, brinjal, capsicum and cucumber. The improved varieties and hybrids of these crops would be evaluated. The high priced vegetables-asparagus, broccoli, leek, tomato, cucumber and capsicum are most important crops for production around metropolis and big cities during winter season or off-season. Thus in the NEH region during winter, it may be useful to grow tomato and capsicum in plastic tunnels as the plants which are protected from cold and frost will manifest faster and better growth resulting in earlier fruiting than the crops grown in the open.

2. Raising off season nurseries: The cost of hybrid seeds is very high. So, it is necessary that every seed must be germinated. For 100% germination, it requires the controlled conditions. The cucurbits are warm season crops. They are sown in last week of March to April when night temperature is around 18-20C. But in polyhouse their seedlings can be raised during December and January in polythene bags. By planting these seedlings during end of February

and Ist week of March in the field, their yield could be taken in one and one and a half months in advance than the normal method of direct sowing. This technology fetches the bonus price due to marketing of produce in the off-season. Similarly, the seedlings of tomato, chilli, capsicum, brinjal, cucumber, cabbage, cauliflower and broccoli can be grown under plastic cover protecting them against frost, severe cold and heavy rains. The environmental condition, particularly increase in temperature inside polyhouse hastens the germination and early growth of warm season vegetable seedlings for raising early crops in spring summer. Vegetable nursery raising under protected conditions is becoming popular throughout the country especially in hilly regions. Management of vegetable nursery in protected structure is easier and early nursery can be raised. Needless to emphasize, this practice eliminates danger of destruction of nurseries by hail storms and heavy rains because world highest rains occur in this region and the period of rainy season is also wide (April to October). Protection against biotic and abiotic stresses becomes easier. Productivity is manifold in greenhouses in comparison to growing the vegetables in open field.

Table 1: Performance of tomato varieties under polyhouse and open field conditions in NEH region (Barapani).

Varieties	Polyhouse yield (q/ha)	Open field yield (q/ha)	Varieties	Polyhouse yield (q/ha)	Open field yield (q/ha)
BT-117-5-3-1	342.00	115.00	Selection-2	233.00	73.83
KT-10	283.60	117.40	Selection-1	2000.98	84.03
BT-10	294.00	111.65	KT-15	211.60	51.65
Arka Alok	260.00	57.90	H-24	243.17	58.75
BT-12	302.40	101.00	Arka Abha	193.50	70.33

4. Vegetable seed production: Seed production in vegetables is the limiting factor for cultivation of vegetables in NEH region of India as well as in India. The vegetables require specific temperature and other climatic conditions for flowering and fruit setting. Seed production of brinjal, capsicum, cauliflower and broccoli is very difficult in open conditions in this area due to high rainfall at maturity stage. To reduce such micro climatic condition, a protected environment is essential. Therefore, the seed production of highly remunerative crops namely tomato, capsicum and cucumber is performed under protected environments. The maintenance and purity of different varieties/lines can be achieved by growing them under greenhouse without giving isolation distance particularly in cross-pollinated vegetables namely onion, cauliflower and cabbage. Hence, vegetable production for domestic consumption and export in low and medium cost greenhouse is a technical reality in India. Such production system has not only extended the growing season of vegetables and their availability but also encouraged conservation of different rare vegetables.

5. Hybrid seed production: In 21st century, protected vegetable production is likely to be commercial practice not only because of its potential but out of sheer necessity. In vegetable production hybrids seeds, transgenic, stress resistant varieties, micropropagated transplants, synthetic seeds are likely to replace conventional varieties. Protected environments will be helpful in production of hybrid seeds of cucumber and summer squash by using gynoecious lines. Gibberlic acid is used to maintain such lines followed by selfing. The desired pollen can be used for production of hybrid seed of cucumber. Similarly in summer squash use of Ethophan in inducing female flower at every node would help in the hybrid seed production by using desired pollen parent.

6. Maintenance and multiplication of self incompatible line for hybrid seed production: In case of cauliflower, there is problem of maintaining and multiplication of potential self-incompatible lines for the production of F1 hybrid seed. Temporary elimination of the self-

incompatibility with the use of CO2 gas has solved this problem. For this purpose, the self-incompatible line is planted in a greenhouse and bees are allowed to pollinate the crop when it is bloom. Then keeping the greenhouse closed tightly, within 2-6 hours of pollination, it is treated with 2-5% CO2 gas which allows successful fertilization by temporarily eliminating the self-incompatibility.

7. Polyhouse for plant propagation: Asparagus, sweet potato, pointed gourd and ivy gourd are sensitive to low temperature. The propagating materials of these vegetables can be well-maintained under polyhouse in winter season before planting their cuttings in early spring-summer season for higher profit.

Status

Commercial greenhouses with climate-controlled devices are very few in the country. Solar greenhouses comprising of glass and polyethylene houses are becoming increasingly popular both in temperate and tropical regions. In early sixties, Field Research Laboratory (FRL) of DRDO at Leh attempted solar greenhouse vegetable production research and made an outstanding contribution to the extent that almost every rural family in Leh valley possesses a polyhouse these days. Indian Petro Chemical Corporation Ltd (IPCL) boosted the greenhouse research and application for raising vegetables by providing Ultra Violet (UV) stabilized cladding film and aluminium polyhouse structures. Several private seed production agencies have promoted greenhouse production of vegetables. In comparison to other countries, India has very little area under greenhouses as is evident from Table 3.

Table 2: Approximate area (ha) under greenhouses

Country	Area	Country	Area
Japan	54000	Turkey	10000
China	48000	Holland	9600
Spain	25000	USA	4000
South Korea	21000	Israel	1500
Italy	18500	India	525

The major share has been in the Leh & Ladakh region of Jammu and Kashmir where commercial cultivation of vegetables is being promoted. In NEH region, polyhouse cultivation is still a new emerging technology for raising nursery of vegetable crops. Assistance provided under the plasticulture scheme since the VIII & IX plan has helped in generating awareness about the importance of greenhouses in enhancing productivity and production, particularly of horticultural crops. out of 525 ha area under greenhouses in India, 83 ha has been covered in the NE states (Table 3), the maximum area being in Sikkim.

Table 3: Cumulative coverage of area (ha) under greenhouse

VIII Plan		1997-98	1998-99	1999-00
All India	211.12	359.35	414.05	525.05
NEH Region	29.05	42.89	59.55	83.4

Types of greenhouse/polyhouse

Low-cost greenhouse/polyhouse: The low cost polyhouse is a zero-energy chamber made of polythene sheet of 700 gauge supported on bamboos with sutli (ropes) and nails. It will be used for protecting the crop from high rainfall. Its size depends upon the purpose and availability of space. The structure depends on the sun for energy. The temperature within polyhouse increases by 6-10^{0}C more than outside. In UV stabilized plastic film covered pipe framed polyhouse, the day temperature is higher and night temperature is lower than the outside. The solar radiation entering the polyhouse is 30-40% lower than that reaching the soil surface outside.

Medium-cost greenhouse/polyhouse: With a slightly higher cost, a Quonset-shaped polyhouse (greenhouse) can be framed with GI pipe (class B) of 15 mm bore. This polyhouse will have a single layer covering of UV-stabilized polythene of 800 gauge. The exhaust fans are used for ventilation. These are thermostatically controlled. Cooling pad is used for humidifying the air entering the polyhouse. The polyhouse frame and glazing material have a life span of about 20 years and 2 years, respectively.

High cost greenhouse/polyhouse: It is constructed on the structure (frame) made of iron/aluminum structure, designed domed shaped or cone shaped (as per choice). Temperature, humidity and the light are automatically controlled as per requirement of the users. Floor and a part of walls are made of concrete. It is highly precautions while operating.

The low and medium-cost greenhouses have wide scope in production of domestic as well as export-oriented vegetables. NEH region recorded highest rainfall in the world. The duration of rainy season is also wide (April-October). During this period, growing of vegetables such as cabbage, cauliflower, broccoli, tomato, brinjal and French bean in open conditions is very difficult. Severe attacks of pest and diseases occur due to heavy rains. So, growing of vegetable crops in low cost polyhouse during this period is very profitable. Control of disease and pest in polyhouse is also easy.

Other plant protection structures

1. **Plastic low tunnels:** Plastic low tunnels are miniature form of greenhouses to protect the plants from rains, winds, low temperature, frost and other vagaries of weather. The low tunnels are very simple structures requiring very limited skills to maintain are easy to constructs and offer multiple advantages. For construction of low tunnels, film of 100 micron would be sufficient. The cost of a 100-micron thick film would be about Rs.10/m^2.
2. **Net houses:** Net houses are used for raising vegetable crops in high rainfall regions. Roof of the structure is covered with suitable cladding material. Sides are made of wire mesh of different gauges. Such structures are useful for NEH region.

Constraints in protected vegetable production

In NEH region polyhouse culture is in infant stage and has not become popular as yet. High cost and non-availability of various components are the two major limiting factors in the adoption of polyhouse technology for commercial cultivation. Many of the polyhouse components like fibreglass, cooling pads, fans, etc., have to be imported at high costs including freight and custom duty. Greenhouse and other structures design for different agro-climatic of the region is not standardized. Lack of awareness among farmers pertaining to potentials of protected vegetable production and lack of major research programme on protected vegetable farming are other limiting factors.

Prospects of protected vegetable production in NEH region

There is a good potential to promote the technology in this region for cultivation of vegetables. The Assam Agricultural University, Jorhat has developed low cost technology for construction of green houses and rain shelters with the use of locally available material like bamboo, which could be availed.

In temperate areas, vegetable growers can increase their income by raising early crops in protected structures mainly in low-cost greenhouses. Raising of vegetable nursery in protected structures has many fold benefits such as easy management, early nursery, and protection from biotic and abiotic stresses. This technology is highly productive, amenable to automation, conserve water and land. In 21st century, protected vegetable production is likely to be common commercial practice not only because of it potential but out of sheer necessity.

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